WHAT IS CLAIMED IS:

1. A two-dimensional dual-frequency antenna, comprising:

a plurality of dual-frequency antennas configured to receive signals having first and second frequencies, and being arrayed to an effective length to re-radiate signals at a third frequency, the third frequency being the difference between the first and second frequencies, each dual-frequency antenna comprising:

a plurality of dipole antennas; and

a plurality of nonlinear resonant circuits, each nonlinear resonant circuit interconnecting at least two of the plurality of dipole antennas and configured to permit re-radiation of signals having the third frequency over the effective length.

2. The two-dimensional dual-frequency antenna according to claim 1, wherein each of the plurality of dipole antennas comprises a half-wavelength dipole.

3. The two-dimensional dual-frequency antenna according to claim 1, wherein each of the plurality of dipole antennas comprises an electric dipole.

4. The two-dimensional dual-frequency antenna according to claim 1, wherein the nonlinear resonant circuit comprises at least one reactive circuit element.

5. The two-dimensional dual-frequency antenna according to claim 4, wherein the at least one reactive circuit element comprises an inductive circuit element interconnecting at least two of the plurality of dipole antennas.

6. The two-dimensional dual-frequency antenna according to claim 5, wherein the inductive circuit element comprises a looped conductor.

7. The two-dimensional dual-frequency antenna according to claim 4, wherein the at least one reactive circuit element comprises a capacitive circuit element interconnecting at least two of the plurality of dipole antennas.

8. The two-dimensional dual-frequency antenna according to claim 7, wherein the capacitive circuit element comprises a parallel plate capacitor.

9. The two-dimensional dual-frequency antenna according to claim 1, wherein the nonlinear resonant circuit comprises at least one nonlinear circuit element interconnecting at least two of the plurality of dipole antennas.

10. The two-dimensional dual-frequency antenna according to claim 9, wherein the nonlinear circuit element comprises a diode.

11. The two-dimensional dual-frequency antenna according to claim 1, wherein the signals having the first and second frequencies intersect at an angle, and wherein the two-dimensional dual-frequency antenna is configured such that the two-dimensional dual-frequency antenna is capable of being rotated relative to a bisector of the angle of intersection to thereby steer a direction of re-radiation of the signals having the third frequency.

12. The two-dimensional dual-frequency antenna according to claim 1, wherein adjacent dual-frequency antennas are spaced apart by a distance selected based upon a fringe period in an interference zone of the signals having the first and second frequencies.

13. The two-dimensional dual-frequency antenna according to claim 12, wherein the two-dimensional dual-frequency antenna is configured such that at least one of the distance between adjacent dual-frequency antennas and the fringe period is capable of being one of increased and decreased to thereby steer a direction of re-radiation of the signals having the third frequency.

14. A method of down-converting at least first and second electromagnetic radiation frequencies:

transmitting a first electromagnetic beam at a first frequency;

transmitting a second electromagnetic beam at a second frequency offset from the first frequency by a difference frequency;

receiving the first and second electromagnetic beams at a two-dimensional dual-frequency antenna comprising a plurality of dual-frequency antennas, each dual-frequency antenna including least two dipole antennas;

converting the first and second frequencies to the difference frequency through a nonlinear resonant circuit coupling the at least two dipole antennas; and

transmitting an electromagnetic beam at the difference frequency from the coupled at least two dipole antennas.

15. The method according to claim 14, wherein the step of transmitting a first electromagnetic beam comprises transmitting in a first direction; the step of transmitting a second electromagnetic beam comprises transmitting in a second direction; and the step of receiving is performed in an interference zone of the first and second electromagnetic beams.

16. The method according to claim 14, further comprising combining the first and second electromagnetic beams in a common direction.

17. The method according to claim 14, further comprising combining first and second electromagnetic beams through a polarization beam combiner.

18. The method according to claim 14, wherein the steps of transmitting first and second electromagnetic beams comprises transmitting first and second electromagnetic beams having a common polarization.

19. The method according to claim 14, wherein the first and second electromagnetic beams intersect at an angle, and wherein the method further comprises rotating the two-dimensional antenna relative to a bisector of the angle of intersection to thereby steer transmission of the electromagnetic beam at the difference frequency.

20. The method according to claim 14, further comprising spacing adjacent dual-frequency antennas of the two-dimensional antenna apart by a distance selected based upon a fringe period in an interference zone of the first and second electromagnetic beams.

21. The method according to claim 20, further comprising one of increasing and decreasing at least one of the distance between adjacent dual-frequency antennas and the fringe period to thereby steer transmission of the electromagnetic beam at the difference frequency.